

Onion Creek Recharge Project
Quality Assurance Project Plan

Barton Springs/Edwards Aquifer
Conservation District
Austin, Texas 78748

Funding Source:

Nonpoint Source Protection Program CWA §319(h)
Prepared in cooperation with the Texas Commission on Environmental Quality
and the U.S. Environmental Protection Agency
Federal ID #C9-996146-11

Effective Period: October 15, 2009 – October 15, 2010

Questions concerning this quality assurance project plan should be directed to:

Brian A. Smith
Barton Springs/ Edwards Aquifer Conservation District
Aquifer Science Team Leader
1124 Regal Row
Austin, TX 78748
512-282-8441
brians@bseacd.org

Summary of Minor Changes: List each section in which a change is proposed and provide a description of the change(s). Include a copy of the changed language (e.g., Organizational changes, Distribution list) in its entirety.

Changes highlighted in Red:

Table A7.1 Measurement Performance Specifications for Automatic and Manual (Grab Sample) Monitoring

| PARAMETER | UNITS | MATRIX | METHOD | PARAMETER CODE | AWRL | Limit of Quantitation (LOQ) | Recovery at LOQ (%) | PRECISION (RPD of LCS/LCSD) | BIAS %Rec. of LCS | Completeness (%) | Field / Lab |
|-----------------------|-------|--------|--------------|----------------|------|-----------------------------|---------------------|-----------------------------|-------------------|------------------|-------------|
| Specific Conductivity | | | | 00095 | | | | | | | |
| Nitrate/Nitrite – N | | | SM4500 NO3-H | | | | | | | | |
| TDS_SM | | | | 70300 | 10 | 10 | | | | | |
| TURB_W Turbidity | | | | 82079 | | | | | | | |

Table B2.2 Stormwater and Base Flow Monitoring

| Parameter | Matrix | Sample Type | Container | Preservation | Sample Volume | Holding Time |
|------------------------|--------|-------------|--------------|------------------------------------|---------------|--------------|
| Total Dissolved Solids | | | | Ice, <6 °C not frozen | | |
| Nitrite+nitrate-N | | | | Ice, <6 °C not frozen, H2SO4, pH<2 | | |
| Total Phosphorus-P | | | | Ice, <6 °C not frozen, H2SO4, pH<2 | | |
| Total Suspended Solids | | | 1000 mL HDPE | Ice, <6 °C not frozen | 1000 mL | |
| Turbidity | | | | Ice, <6 °C not frozen | | |

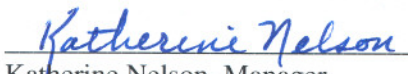
Texas Commission on Environmental Quality

Compliance Support Division

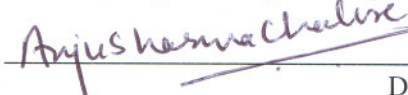

Stephen Stubbs, QA Manager 10/30/09
Quality Assurance Section Date


Kyle Gitten, QA Specialist 10/29/09
Quality Assurance Team Date

Water Quality Planning Division

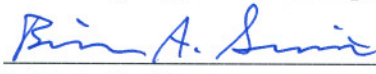

Katherine Nelson, Manager 10/20/09
Water Quality Planning and Implementation Section Date


Kerry Niemann, Manager 10/20/09
Nonpoint Source Program Date


August Hornachalove 10/16/09
Project QA Specialist Nonpoint Program Date


Mark Palmie 10-15-09
Project Manager, Nonpoint Source Program Date

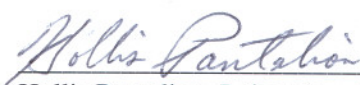
Barton Springs/Edwards Aquifer Conservation District


Brian A. Smith Oct. 1, 2009
Date


Brian B. Hunt, QA Officer 10/1/09
Date

LCRA Environmental Laboratory Services


Alicia Gill, Laboratory Director 10/08/09
Date


Hollis Pantaloni, Laboratory QA Officer 10/14/09
Date

The contractor will secure written documentation from additional project participants (e.g., subcontractors, laboratories) stating the organization's awareness of and commitment to requirements contained in this quality assurance project plan and any amendments or revisions of this plan. The Planning Agency will maintain this documentation as part of the project's quality assurance records, and will be available for review.

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A3 Distribution List

BSEACD will provide copies of this project plan and any amendments or revisions of this plan to each project participant defined in the list below. BSEACD will document receipt of the plan by each participant and maintain this documentation as part of the project's quality assurance records. This documentation will be available for review.

**Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087**

Kyle Girten, Quality Assurance Specialist
MC-176
(512) 239-0425

Mark Palmie, NPS Project Manager
MC-147
(512) 239- 0849

**Barton Springs/Edwards Aquifer Conservation District
1124 Regal Row
Austin, TX 78748**

Brian A. Smith, Project Manager
(512) 282-8441

Brian Hunt, Quality Assurance Officer
(512) 282-8441

**LCRA Environmental Laboratory Services
3505 Montopolis
Austin, TX 78744**

Alicia Gill, Laboratory Manager
(512) 356-6022

Hollis Pantalion, Laboratory Quality Assurance Officer
(512) 356-6022

**U.S. Environmental Protection Agency Region 6
Section Name
1445 Ross Avenue
Suite # 1200
Dallas, TX 75202-2733**

Randall Rush, Project Officer
(214) 665-7107

List of Acronyms

| | |
|--------|--|
| AWRL | Ambient Water Reporting Limit |
| BMP | Best Management Practice |
| BSEACD | Barton Springs/Edwards Aquifer Conservation District |
| CAR | Corrective Action Report |
| COC | Chain of Custody |
| CRP | Clean Rivers Program |
| CWA | Clean Water Act |
| DOC | Demonstration of Capability |
| DMP | Data Management Plan |
| DMRG | Data Management Reference Guide |
| DQO | Data Quality Objective |
| EPA | Environmental Protection Agency |
| GIS | Geographic Information System |
| LCS | Laboratory Control Sample (formerly Laboratory Control Standard) |
| LCSD | Laboratory Control Sample Duplicate (formerly Laboratory Control Standard Duplicate) |
| LOD | Limit of Detection |
| LOQ | Limit of Quantitation (formerly reporting limit) |
| NCR | Nonconformance Report |
| NELAC | National Environmental Laboratory Accreditation Conference |
| NPDES | National Pollutant Discharge Elimination System |
| NPS | Nonpoint Source |
| PO | Project Officer |
| QA/QC | Quality Assurance/Quality Control |
| QAM | Quality Assurance Manual |
| QAO | Quality Assurance Officer |
| QAPP | Quality Assurance Project Plan |
| QAS | Quality Assurance Specialist |
| QMP | Quality Management Plan |
| RPD | Relative Percent Difference |
| SLOC | Station Location Form |
| SOP | Standard Operating Procedure |

| | |
|--------|---|
| SWQM | Surface Water Quality Monitoring |
| SWQMIS | Surface Water Quality Monitoring Information System |
| TCEQ | Texas Commission on Environmental Quality |
| TSWQS | Texas Surface Water Quality Standards |
| WQI | Water Quality Inventory |

A4 Project/Task Organization

TCEQ

Compliance Support Division

Kyle Girten

TCEQ Lead QA Specialist

Assists the TCEQ Project Manager in QA related issues. Serves on planning team for NPS projects. Participates in the planning, development, approval, implementation, and maintenance of the QAPP. Determines conformance with program quality system requirements. Coordinates or performs audits, as deemed necessary and using a wide variety of assessment guidelines and tools. Concurs with proposed corrective actions and verifications. Monitors corrective action. Provides technical expertise and/or consultation on quality services. Provides a point of contact at the TCEQ to resolve QA issues. Recommends to TCEQ management that work be stopped in order to safe guard project and programmatic objectives, worker safety, public health, or environmental protection.

Water Quality Planning Division

TCEQ NPS Program Manager

Responsible for management and oversight of the TCEQ NPS Program. Oversees the development of QA guidance for the NPS program to be sure it is within pertinent frameworks of the TCEQ. Monitors the effectiveness of the program quality system. Reviews and approves all NPS projects, internal QA audits, corrective actions, reports, work plans, and contracts. Enforces corrective action, as required. Ensures NPS personnel are fully trained and adequately staffed.

Mark Palmie

TCEQ NPS Project Manager

Maintains a thorough knowledge of work activities, commitments, deliverables, and time frames associated with projects. Develops lines of communication and working relationships between the BSEACD, the TCEQ, and the EPA. Tracks deliverables to ensure that tasks are completed as specified in the contract. Responsible for ensuring that the project deliverables are submitted on time and are of acceptable quality and quantity to achieve project objectives. Serves on planning team for NPS projects. Participates in the development, approval, implementation, and maintenance of the QAPP. Assists the TCEQ QAS in technical review of the QAPP. Responsible for verifying that the QAPP is followed by BSEACD. Notifies the TCEQ QAS of particular circumstances which may adversely affect the quality of data derived from the collection and analysis of samples. Enforces corrective action.

TCEQ NPS Project Quality Assurance Specialist

Assists Lead QAS with NPS QA management. Serves as liaison between NPS management and Agency QA management. Responsible for NPS guidance development related to program quality assurance. Serves on planning team for NPS projects. Participates in the development, approval, implementation, and maintenance of the QAPP.

TCEQ NPS Data Manager

Responsible for tracking and verifying of NPS data. Maintains data storage system for NPS quality assured datasets. Coordinates correction of data errors with TCEQ NPS Project Managers and BSEACD Data Managers. Provides training and guidance to BSEACD on technical data issues. Serves on planning team for NPS projects. Reviews and approves data-related portions of project-specific QAPPs. Performs technical reviews of project-specific Data Management Plans. Develops and maintains Standard Operating Procedures for NPS data management.

Barton Springs/Edwards Aquifer Conservation District (BSEACD)

Brian Smith

BSEACD Project Manager

Responsible for ensuring tasks and other requirements in the contract are executed on time and are of acceptable quality. Monitors and assesses the quality of work. Coordinates attendance at conference calls, training, meetings, and related project activities with the TCEQ. Responsible for verifying the QAPP is followed and the project is producing data of known and acceptable quality. Ensures adequate training and supervision of all monitoring and data collection activities. Complies with corrective action requirements.

Brian Hunt

BSEACD QAO

Responsible for coordinating development and implementation of the QA program. Responsible for writing and maintaining the QAPP. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Responsible for maintaining written records of sub-tier commitment to requirements specified in this QAPP. Responsible for identifying, receiving, and maintaining project quality assurance records. Responsible for coordinating with the TCEQ QAS to resolve QA-related issues. Notifies the BSEACD Project Manager and TCEQ Project Manager of particular circumstances which may adversely affect the quality of data. Responsible for validation and verification of all data collected according to Section D2 procedures and acquired data procedures after each task is performed. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Conducts laboratory inspections. Develops, facilitates, and conducts monitoring systems audits.

Nathaniel Banda

BSEACD Data Manager

Responsible for the acquisition, verification, and transfer of data to the TCEQ. Oversees data management for the study. Performs data quality assurances prior to transfer of data to TCEQ. Responsible for transferring data to the TCEQ in the acceptable format. Ensures data are submitted according to workplan specifications. Provides the point of contact for the TCEQ Data Manager to resolve issues related to the data.

Joseph Beery

BSEACD Field Supervisor

Responsible for supervising all aspects of the sampling and measurement of surface waters and other parameters in the field. Responsible for the acquisition of water samples and field data measurements in a timely manner that meet the quality objectives specified in Section A7 (Table A7.1), as well as the

requirements of Sections B1 through B8. Responsible for field scheduling, staffing, and ensuring that staff are appropriately trained as specified in Sections A6 and A8.

LCRA Environmental Laboratory Services

Alicia Gill Laboratory Manager

Responsible for supervision of laboratory personnel involved in generating analytical data for this project. Responsible for ensuring that laboratory personnel involved in generating analytical data have adequate training and a thorough knowledge of the QAPP and all SOPs specific to the analyses or task performed and/or supervised. Responsible for oversight of all operations, ensuring that all QA/QC requirements are met, and documentation related to the analysis is completely and accurately reported. Enforces corrective action, as required. Develops and facilitates monitoring systems audits.

Hollis Pantalion Laboratory QAO

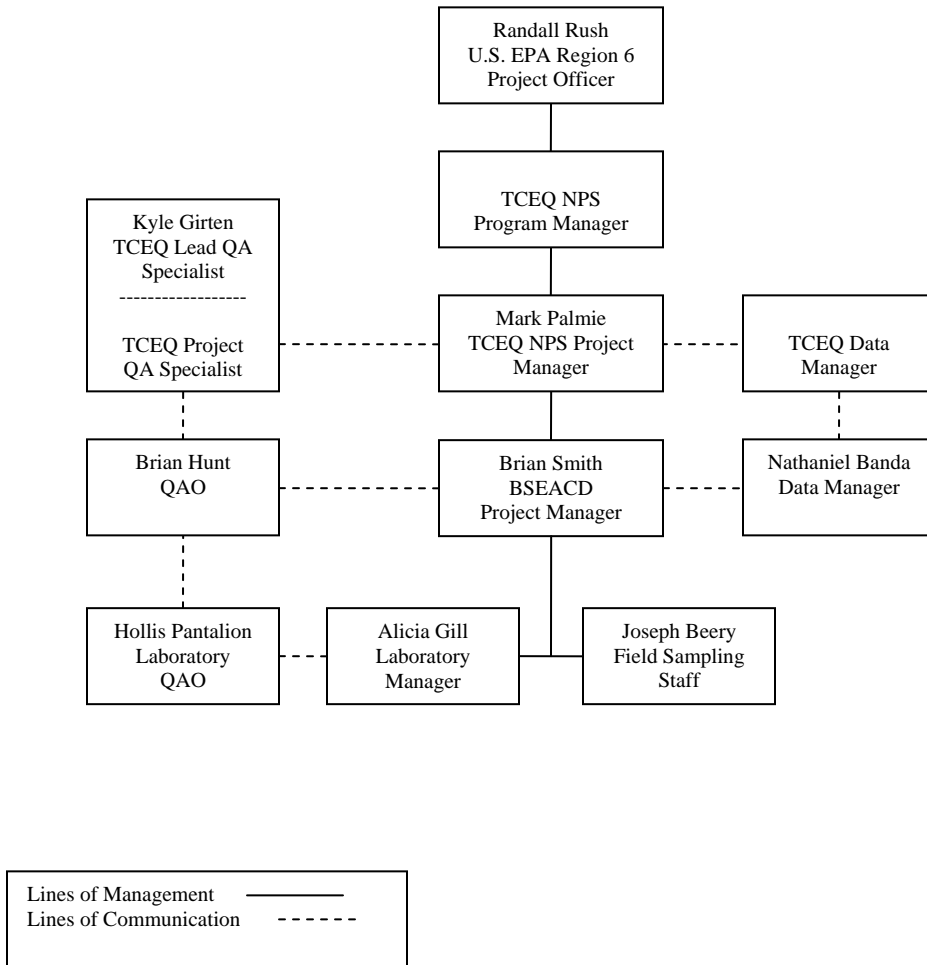
Monitors the implementation of the QAM and the QAPP within the laboratory to ensure complete compliance with QA objectives as defined by the contract and in the QAPP. Conducts internal audits to identify potential problems and ensure compliance with written SOPs. Responsible for supervising and verifying all aspects of the QA/QC in the laboratory. Performs validation and verification of data before the report is sent to BSEACD. Insures that all QA reviews are conducted in a timely manner from real-time review at the bench during analysis to final pass-off of data to the QA officer.

U.S. EPA Region 6

Randall Rush EPA Project Officer

Responsible for managing the CWA Section 319 funded grant on the behalf on EPA. Assists the TCEQ in approving projects that are consistent with the management goals designated under the State's NPS management plan and meet federal guidance. Coordinates the review of project workplans, draft deliverables, and works with the State in making these items approvable. Meets with the State at least semi-annually to evaluate the progress of each project and when conditions permit, participate in a site visit on the project. Fosters communication within EPA by updating management and others, both verbally and in writing, on the progress of the State's program and on other issues as they arise. Assists the regional NPS coordinator in tracking a State's annual progress in its management of the NPS program. Assists in grant close-out procedures ensuring all deliverables have been satisfied prior to closing a grant.

Figure A4.1. Organization Chart - Lines of Communication



A5 Problem Definition/Background

The Edwards Aquifer, located in south-central Texas, is one of the most prolific karst aquifers in the United States and is an important groundwater resource for municipal, industrial, domestic, agricultural, recreational, and ecological needs. The aquifer extends about 270 miles from the Rio Grande River along the Mexico/United States border at Del Rio, east to San Antonio, then northeast through Austin to Salado. Hydrologic divides separate the Edwards Aquifer into three major segments: the San Antonio, Barton Springs, and Northern segments and numerous subsections.

The Barton Springs segment of the Edwards Aquifer is the focus of this project (Appendix A). Approximately 50,000 people depend on water from the Barton Springs aquifer as their sole source of drinking water, and the various spring outlets at Barton Springs are the only known habitats for the endangered Barton Springs salamander.

Up to 85 percent of recharge to the aquifer is derived from streams originating on the contributing zone, located up gradient and west of the recharge zone. Water flowing onto the recharge zone sinks into numerous caves, sinkholes, and fractures recharging the aquifer. Groundwater then moves northeast toward wells and Barton Springs. Onion Creek contributes about one third of all recharge, with most of that recharge occurring within several discrete recharge features within the creek bottom (Appendix A).

EPA identifies karst aquifers as one of the most vulnerable to pollution because of their rapid groundwater velocities and limited ability to filter contaminants. Numerous tracer tests have been performed on the Barton Springs aquifer demonstrating that rapid groundwater flow occurs in an integrated network of conduits discharging at wells and springs. A portion of this groundwater flows from the conduits into the diffuse matrix of the aquifer building up storage in the aquifer. Water from storage flows diffusely to wells or back into the conduit network. This dual flow system results in contamination having the potential to rapidly impact wells and springs, as well as slowly accumulate and move within the matrix of the aquifer.

The TCEQ lists the Barton Springs aquifer on a list of impaired groundwater resources. Onion Creek is listed on the 303(d) list of impaired streams. Increases in sediment, bacteria, and other contaminants in groundwater as a result of storm-flow events in the Barton Springs aquifer have been documented by analysis of water samples from monitor and water-supply wells.

To reduce the amount of sediment and other storm-related contaminants entering some of these recharge features, automated control systems will be designed and installed over two recharge features on Onion Creek. The first site for installation of a monitoring system is Antioch Cave, which already has a BMP that controls flow into the cave. However, the BMP needs to be manually operated, so it does not function at its maximum potential.

During periods of storm water flow in the creek, valves will be closed to prevent entry of sediment-laden water into the recharge features. Continuous water quality monitoring network (CWQMN) systems will be installed at each site that will monitor turbidity and other parameters in water flowing in the creek. When turbidity reaches a level indicative of storm-water flow, the valve will be automatically closed. When turbidity drops to a level consistent with no storm-water flow, the valve will be opened, allowing better quality water to enter the aquifer. Operation of these systems will decrease the amount of sediment and other storm-water related contaminants entering the aquifer. This will improve the quality of water in the aquifer that thousands of users rely upon and that the endangered salamanders need for survival.

The District's initial 319h proposal submitted for the Onion Creek BMP project consisted of two CWQMN sites, namely, Antioch Cave, and Site "B. The District is continuing with the assessment for Site B, and once the District has selected the physical location, the District will at that time submit an amendment to the current QAPP to reflect the addition of Site B and all pertinent information to meet grant criteria.

A6 Project/Task Description

The installation of a Continuous Water Quality Monitoring Network (CWQMN) in the Onion Creek watershed will enhance water quality in the Barton Springs segment of the Edwards Aquifer (Barton Springs aquifer) by activating best management practice structures (BMPs) that will exclude "first flush" rainfall runoff from the aquifer.

This project's goal is to improve water quality in the Barton Springs aquifer by facilitating timely and efficient responses to recharge events by continuously monitoring water quality in the Onion Creek Watershed and excluding "first flush" flows of contaminated storm water into recharge features on Onion Creek. This will be accomplished using BMPs with valves that either currently exist, or will be installed, and automatically opening the valves when the storm water pulse has passed to allow continued recharge of clean surface water into the aquifer. The valves will be triggered based on CWQMN data. The valves will close when turbidity is determined to be high. The valves will reopen when turbidity lowers to acceptable concentrations.

This implementation assessment project will provide operation and maintenance of two automated remote water-quality monitoring sites for up to three years. One site is the existing Antioch Cave BMP. A second site will be identified and the BMP implemented during the course of this grant. Each automated CWQMN site in the Onion Creek Watershed will analyze ambient water for DO, turbidity, temperature and conductivity. Continuous water-quality monitoring will be conducted in accordance with TCEQ's established CWQMN quality assurance project plan (QAPP). Data will be transmitted to TCEQ electronically to be uploaded into the LEADS system.

Water samples from Onion Creek will also be collected by using an automatic sampler during three to five storm flow events and manual (grab) samples will be collected for base flow samples between storm events.

Samples will be analyzed for TSS, TDS, turbidity, nitrate and nitrite as N, and total phosphate. Automated samplers will collect samples when triggered by a storm event. Water quality data will be used to determine the amount of pollutant loads (nitrate/nitrite, phosphorus, and sediment) that are prevented from entering the aquifer by operation of the Antioch and Site B BMPs. This will be accomplished by first calculating the amount of contaminants in Onion Creek during the storm pulse and then calculating the amount of water not entering the aquifer when the valve is closed. This volume will be determined by taking the flow rate of water entering the BMP when the valve is first opened following a storm event multiplied by the length of time the valve was closed. The masses of nitrate/nitrite, phosphorous, and sediment prevented from entering the aquifer will be calculated with the following formula:

$$Q * C_{N,P,S} * T = M_{N,P,S}$$

where

Q = Rate of flow into Antioch BMP when valve is first opened following storm pulse

$C_{N,P,S}$ = Concentration of N (nitrate/nitrite), P (phosphorous), or S (sediment) during storm pulse

T = Duration of time that valve on BMP was closed

$M_{N,P,S}$ = Mass of contaminant prevented from entering aquifer

See Section B1 for monitoring to be conducted under this QAPP.

Revisions to the QAPP

Revisions may be made to this QAPP following selection of the second site to address sampling and monitoring activities that might vary between sites.

Until the work described is completed, this QAPP shall be revised as necessary and reissued annually on the anniversary date, or revised and reissued within 120 days of significant changes, whichever is sooner. The most recently approved QAPPs shall remain in effect until revisions have been fully approved; reissuances (i.e., annual updates) must be submitted to the TCEQ for approval before the last version has expired. If the entire QAPP is current, valid, and accurately reflects the project goals and organization's policy, the annual reissuance may be done by a certification that the plan is current. This can be accomplished by submitting a cover letter stating the status of the QAPP and a copy of new, signed approval pages for the QAPP.

Amendments

Amendments to the QAPP may be necessary to reflect changes in project organization, tasks, schedules, objectives, and methods; address deficiencies and nonconformances; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Requests for amendments are directed from the BSEACD Project Manager to the TCEQ Project Manager in writing using the QAPP Amendment shell. The changes are effective immediately upon approval by the TCEQ NPS Project Manager and Quality Assurance Specialist, or their designees, and the EPA Project Officer.

Amendments to the QAPP and the reasons for the changes will be documented, and revised pages will be forwarded to all persons on the QAPP distribution list by the BSEACD QAO. Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process or within 120 days of the initial approval in cases of significant changes.

A7 Quality Objectives and Criteria

The objectives of the data collection efforts of this project are as follows:

Continuous water quality monitoring will be conducted to operate a valve over a recharge feature for the Barton Springs segment of the Edwards Aquifer. Continuous water quality monitoring will also obtain information about water quality in Onion Creek and water quality entering the aquifer. CWQMN Data will be telemetered to TCEQ to be uploaded into the LEADS system.

Data from automatic samplers will be used to calculate the pollutant loads associated with stormwater runoff events in Onion Creek.

Manual grab samples will be collected to determine the amount of sediment and contaminants that enter the aquifer through Antioch Cave when the valve is open. These values will be compared to values for storm flow when the valve on the Antioch BMP is closed. Such a comparison will give us a better understanding of the quality of water entering the aquifer along Onion Creek. With that knowledge, we can better understand non-point source pollution in the Onion Creek watershed. Grab samples, that will be representative of base flow conditions, will be collected following each sampled storm event. The only exceptions will be for back-to-back storm events for which there will insufficient time to coordinate sampling.

Onion Creek Recharge Project will employ only methods and techniques which have been determined to produce measurement data of a known and verifiable quality and which are sufficient to meet the objectives of the project.

Measurement Quality Objectives (MQOs) and Data Quality Objectives (DQOs) to support the Continuous Water Quality Monitoring Network (CWQMN) objectives are specified in Tables A7.2 and A7.3, respectively. Data Quality Objectives for automatic sampling data are in table A7.1. The quality control (QC) program has been developed with these objectives in mind. Methods used for water-quality measurements in the CWQMN are based on *Standard Methods used for the Examination of Water and Wastewater*, 20th Edition, 1998 unless otherwise specified.

Table A7.1 Measurement Performance Specifications for Automatic and Manual (Grab Sample) Monitoring

| PARAMETER | UNITS | MATRIX | METHOD | PARAMETER CODE | AWRL | Limit of Quantitation (LOQ) | Recovery at LOQ (%) | PRECISION (RPD of LCS/LCSD) | BIAS %Rec. of LCS | Completeness (%) | Field / Lab |
|-----------------------|-------|--------|------------------------|----------------|------|-----------------------------|---------------------|-----------------------------|-------------------|------------------|-------------|
| Specific Conductivity | uS/cm | water | EPA 120.1 and TCEQ SOP | 00095 | NA | NA | NA | NA | NA | 90 | Lab |
| Nitrate/Nitrite – N | mg/l | water | SM4500 NO3-H | 00630 | .05 | 0.02 | 70-130 | 20 | 80-120 | 90 | Lab |
| Total Phosphorus | mg/L | water | EPA 365.4 | 00665 | .06 | 0.06 | 70-130 | 20 | 80-120 | 90 | Lab |
| TSS_SM | mg/L | water | SM 2540 D | 00530 | 4 | 1 | NA | 20 | 80-120 | 90 | Lab |
| TDS_SM | mg/l | water | SM 2540 C | 70300 | 10 | 10 | NA | 20 | 80-120 | 90 | Lab |
| TURB_W Turbidity | NTU | water | SM 2130 B | 82079 | NA | NA | NA | NA | NA | 90 | Lab |

References: US EPA Methods for Chemical Analysis of Water and Wastewater, Manual #EPA-600/4-79-020. American Public Health Association, American Water Works Association and Water Environment Federation, *Standard Methods for the Examination of Water and Waste Water*, 20th Ed., Texas Commission on Environmental Quality *Surface Water Quality Monitoring Procedures*, Volume 1.

** Based on range statistic as described in Standard Methods, 21st Edition, Section 9020-B, Quality Assurance/Quality Control - Intralaboratory Quality Control Guidelines. This criterion applies to bacteriological duplicates with concentrations >10 MPN/100mL or > 10 org./100 mL.

Table A7.2 DQOs for Continuous Water-Quality Monitoring Sondes (Multi-Probes)

| Parameter | Parameter Code | Units | Measurement Equipment | Method | Calibration Verification Sample (CVS)** |
|-------------|----------------|--------------|-----------------------|-----------------------------|---|
| DO | 00300 | mg/L | In-Situ MP Troll 9500 | ASTM#D888-05 Method C | % Saturation ≤ 6.0% ± 0.50 mg/L |
| SC | 00094 | US/cm | In-Situ MP Troll 9500 | Std. Mthds. 2510, EPA 120.1 | ≤ 5.0% RPE |
| Depth | NA | Feet @ 30psi | In-Situ MP Troll 9500 | NA | NA |
| Turbidity | NA | NTU | In-Situ MP Troll 9500 | Optical | NA |
| Temperature | 00010 | Celsius | In-Situ MP Troll 9500 | EPA 170.1 | NA |

**CVS criteria for use in the 305(b) and 303(d) Lists per SWQM DQOs.
 NA = Not Applicable

Table A7.3 MQOs for 500 KHZ Acoustic Doppler Current Profiler (ADCP) Flow Meters

| Parameter | SOP | Flow Meter | Units | Method | Range ¹ | Range ² | Resolution | Accuracy |
|--|-------|--------------------------------------|-------|--------------------------------------|--------------------|--------------------|------------------------|----------|
| Volumetric Flow Rate Water Velocity | 00094 | Shallow Water (Intermittent Streams) | CFS | Doppler Ultrasonic, frequency 500kHz | 0.033 to 5.0 ft | -5 to 20 ft/s | +0.01 ft + 0.1 ft/s | TBD |

1- vertical beam
 2- water velocity
 CFS = cubic feet per second
 TBD = To be determined. This information will be provided in an amendment to the QAPP.

Precision

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. It is a measure of agreement among replicate measurements of the same property, under prescribed similar conditions, and is an indication of random error.

Field splits are used to assess the variability of sample handling, preservation, and storage, as well as the analytical process, and are prepared by splitting samples in the field. Control limits for field splits are defined in Section B5.

Laboratory precision is assessed by comparing replicate analyses of laboratory control samples in the sample matrix (e.g. deionized water, sand, commercially available tissue). Precision results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for precision are defined in Table A7.1.

Bias

Bias is a statistical measurement of correctness and includes multiple components of systematic error. A measurement is considered unbiased when the value reported does not differ from the true value. Bias is determined through the analysis of laboratory control samples and LOQ Check Standards prepared with verified and known amounts of all target analytes in the sample matrix (e.g. deionized water, sand, commercially available tissue) and by calculating percent recovery. Results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for bias are specified in Table A7.1.

Representativeness

Representativeness is the degree to which data accurately and precisely represents a characteristic of a population, a process condition, or an environmental condition. The data will be considered representative of the target population or phenomenon to be studied. Site selection, the appropriate sampling regime, the sampling of all pertinent media according to TCEQ SOPs, and use of only approved analytical methods will assure that the measurement data represents the conditions at the site. Continuous data collected for water-quality assessment are considered to be spatially and temporally representative of the full range of water quality conditions over time. Continuous water-quality data are collected on a routine frequency and are separated by even time intervals. Depending on data storage capabilities, readings will be made between every 1 to 10 minutes. The intent of the stormwater sampling component is to define the water-quality profile(s) of stormwater events within the Onion Creek watershed with the parameters listed in Table A7.1. Stormwater samples will be collected by an automatic sampling device for the duration of the stormwater event. For a single stormwater event within the Onion Creek watershed, four to seven samples will accurately represent the over-all water quality of that storm event. Although data may be collected during varying regimes of weather and flow, the continuous water-quality data sets will not be biased toward unusual conditions of flow, runoff, or season. Stormwater samples will be representative of water quality during storm events or of base-flow (non-storm) conditions. The goal for meeting total representation of Onion Creek will be tempered by the potential funding for complete representativeness.

Completeness

The completeness of the data is basically a relationship of how much of the data is available for use compared to the total potential data. Ideally, 100% of the data should be available. However, the

possibility of unavailable data due to accidents, insufficient sample volume, broken or lost samples, etc. is to be expected. Therefore, it will be a general goal of the project(s) that 90% data completion is achieved.

Comparability

Confidence in the comparability of routine data sets for this project and for water quality assessments is based on the commitment of project staff to use only approved sampling and analysis methods and QA/QC protocols in accordance with quality system requirements and as described in this QAPP and in TCEQ SOPs. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for rounding figures, and by reporting data in a standard format as specified in Section B10.

Limit of Quantitation

AWRLs (Table A7.1 and A7.2) are used in this project as the *limit of quantitation* specification, so the Water Quality Standards can be used as the benchmarks to compare data against. Laboratory *limits of quantitation* (Table A7.1 and A7.2) must be at or below the AWRL for each applicable parameter.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria are provided in Section B5.

Analytical Quantitation

To demonstrate the ability to recover at the limit of quantitation, the laboratory will analyze an LOQ check standard on each day samples are run.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria are provided in Section B5.

DQOs for CWQMN

Additional DQOs for the CWQMN portion of this project are provided in Section A7 of the CWQMN QAPP.

A8 Special Training/Certification

Staff responsible for operating the automated samplers and flow meters will undergo a training session by the project equipment vendor.

Field personnel will receive training in proper sampling and field analysis. Before actual sampling or field analysis occurs, they will demonstrate to the QA officer (in the field), their ability to properly operate the automatic samplers and retrieve the samples. The QA officer will sign off each field staff in their field logbooks.

BSEACD and subcontractors must ensure that laboratories analyzing samples under this QAPP meet the requirements contained in Section 5.4.4 of the NELAC standards (concerning Review of Requests, Tenders and Contracts).

The District will follow and adhere to Section A8 of the CWQMN QAPP.

A9 Documents and Records

See Section B10 of the CWQM QAPP for electronic management of Continuous Water Quality Monitoring Network Data.

The District will follow and adhere to the CWQM QAPP for Section A9 as described in A9.1 through A9.4.

Laboratory Test Reports

Test/data reports from the laboratory must document the test results clearly and accurately. Routine data reports will be consistent with the NELAC standards (Section 5.5.10) and include the information necessary for the interpretation and validation of data. The requirements for reporting data and the procedures are provided below.

- Report title
- Name and address of laboratory
- Name and address of client and project name
- Sample results
- Units of measurement
- Sample matrix
- Dry weight or wet weight (as applicable)
- Station information
- Date and time of collection
- LOQ and LOD (formerly referred to as the reporting limit and the method detection limit, respectively), and qualification of results outside the working range (if applicable)
- An explanation of failed QC and any non-standard conditions that may have affected quality
- A signature and title of laboratory director or designee

Electronic Data

Only CWQM data will be reported electronically to TCEQ. Data will be submitted to the TCEQ in the format specified by the TCEQ Project Manager. The Data Summary as contained in Appendix C of this document will be submitted with the data.

In-situ water quality and water level measurements are logged once every 15 minutes by the data logger. The data is then transmitted to the MeteoStar/LEADS system in Austin, Texas where the data is ingested, archived, and posted to the appropriate TCEQ internet site.

A station location request (SLOC) will be submitted to the TCEQ Project Manager for each sampling site to obtain a station identification number.

Records and Documents Retention Requirements

| Document/Record | Location | Retention | Form |
|---|----------|-----------|--------------------|
| QAPP, amendments, and appendices | Org. | 5 years | Paper |
| QAPP distribution documentation | Org. | 5 years | Paper |
| Training records | Org. | 5 years | Paper |
| Field notebooks or field data sheets | Org. | 5 years | Paper |
| Field equipment calibration/maintenance 1 | Org. | 5 years | Paper |
| Chain of custody records | Org. | 5 years | Paper |
| Field SOPs | Org. | 5 years | Paper |
| Laboratory QA manuals | Lab | 5 years | Electronic |
| Laboratory SOPs | Lab | 5 years | Electronic |
| Laboratory procedures | Lab | 5 years | Electronic |
| Instrument raw data files | Lab | 5 years | LIMS Electronic |
| Instrument readings/printouts | Lab | 5 years | Paper + Electronic |
| Laboratory data reports/results | Lab | 5 years | Electronic |
| Laboratory equipment maintenance logs | Lab | 5 years | Electronic |
| Laboratory calibration records | Lab | 5 years | LIMS Electronic |
| Corrective action documentation | Lab | 5 years | Electronic |

B1 Sampling Process Design (Experimental Design)

Sample Design Rationale

CWQMN

Data collected by the CWQMN system will be used to trigger the opening and closing of the valve on the Antioch BMP. As a storm pulse is recognized by high turbidity readings on the CWQMN instruments, a signal will be sent automatically to the valve control mechanism for the valve to close. As turbidity readings drop below a pre-set level that indicates approach to base flow conditions, the valve will be opened to allow the cleaner water in Onion Creek to recharge the aquifer. Additional sample design rationales for the CWQMN portion of this project are described in Section B1 of the CWQMN QAPP.

Automatic Sampling (Stormwater)

The sample design rationale for stormwater sampling for this study is based on the intent to quantify the amount of sediment and other contaminants that are prevented from entering the Edwards Aquifer by the automated operation of an existing BMP situated over Antioch Cave and a yet-to-be-built BMP at another location (Site B). Monitoring sites are specified in Table B1.1. Since the valves on the BMPs will be closed during periods of high storm flow, the amount of sediment and other contaminants in the surface water during this period needs to be determined. The stormwater sampling program will focus on the collection of samples that represent the highest amount of flow from a given storm and the collection of samples as the storm pulse subsides to develop a water-quality profile of the stormwater event. It is anticipated that between three to five storm events will be sampled at the Antioch BMP for the duration of the project. For each of these events, between four to seven samples will be collected. One to three samples will be collected near the maximum stream flow, one or two samples will be collected as the storm pulse is rapidly subsiding, and another one or two samples will be collected when turbidity levels of the water are close to stabilizing. It is estimated that the number of days between peak flow and the

time at which sediment load and turbidity have decreased to the point that the valve on the BMP should be opened could vary between 3 to 10 days. The sampling schedule will be set to cover this amount of time initially. As data are collected from the first storm events, the sampling schedule will be refined.

An ISCO 3700 series automatic sampler and an ISCO 4230 bubbler flow meter will be installed at Antioch. The bubbler flow meter will measure the water level (stage) in Onion Creek at the Antioch BMP. The flow meter will be programmed to log water level every 5 minutes to trigger the automatic sampler to start sampling and be used to pace the sample intervals based on water level. The sampler and flow meter will be placed at such a distance and elevation from the BMP so that the sampler pump will be capable of delivering samples to the bottles in the sampler. Because that location might not be above the maximum flood stage for that section of Onion Creek, there is a possibility that the sampler could be inundated under extremely high flood conditions. If that occurs, the sampler will be inspected and repaired or replaced if necessary.

The automatic sampler will be programmed to collect samples starting when the increase in water level indicates that the beginning of storm flow has reached Antioch. The actual amount of water-level rise indicative of a storm event will be determined once a bubbler flow meter or other water-level measurement instrument is installed at Antioch. Samples will be collected every 2 to 6 hours depending on the anticipated duration of the storm flow. Sampling will continue until the water level drops below 75 percent of the peak flow compared to flow at the start of sampling, or until 10 days after start of sampling, whichever ever comes first. The cutoff for sample collection will also be evaluated once the BMP is instrumented for water-level measurements. The cutoff point is likely to vary considerably for each storm event.

Each sample will be acidified as appropriate, iced and transported to the laboratory where they will be stored at $<4^{\circ}\text{C}$ prior to analysis.

Grab Samples (Base Flow)

Either before a predicted storm event, or well after a storm event, District staff will manually collect an instream sample (grab sample) that will be representative of base flow conditions in Onion Creek. Grab samples will be handled and analyzed as described above for automatic samples. Base flow conditions need to be determined to better understand conditions during storm events. Grab samples will be collected following each sampled storm event. The only exceptions will be for back-to-back storm events for which there will insufficient time to coordinate sampling.

Monitoring and Support Equipment

In addition to the sampling equipment mentioned above, the Antioch site will include the following equipment:

- In-Situ Troll 9500 multi-parameter water quality probe (temperature, conductivity, DO, turbidity, pressure)
- In-Situ Level Troll 500 (temperature, pressure)
- Zeno data logger
- Enfora modem and cellular telephone
- ISCO 2150 flow meter with area velocity/pressure
- Air compressor and tank

This equipment will be part of TCEQ’s Continuous Water Quality Monitoring Network (CWQMN). The equipment that will be installed on or near the Antioch BMP will be the Troll 9500, Troll 500, and flow meter. An equipment shed will be constructed above flood stage to house the Zeno data logger, modem, communications equipment, air compressor and tank. Cables to connect the data logger to the probes will be run through a PVC conduit that will be buried in a trench for a portion of the distance between the BMP and the equipment shed.

Data collected with the above equipment (temperature, conductivity, DO, turbidity, pressure, and stream flow) will be telemetered to the TCEQ LEADS System with a cellular telephone.

A similar CWQMN system will be installed at Site B, once that site has been selected.

Table B1.1 Monitoring Sites

| TCEQ Station ID | Site Description | Latitude Longitude | Start Date | End Date | Sample Matrix | Monitoring Frequencies (per year) | | |
|-----------------|--------------------------------------|--------------------|----------------------------|----------|---------------|-----------------------------------|-----------|---|
| | | | | | | Total Suspended Solids | Nutrients | Comments |
| Pending* | Antioch Cave BMP | TBD | 15 days from QAPP approval | 8/31/09 | water | 2 to 4 | 2 to 4 | 3 to 5 sampling events will be tied to rainfall, stage to discharge relationship, |
| Pending* | Site B (upstream – to be determined) | TBD | 15 days from QAPP approval | 8/31/09 | water | 2 to 4 | 2 to 4 | 3 to 5 sampling events will be tied to rainfall, stage to discharge relationship |

*SLOC numbers have been requested.

B2 Sampling Methods

The District will follow and adhere to Section B2 of the CWQMN QAPP, excluding the Continuous Monitoring Auto Analyzer or equivalent equipment.

Field Sampling Procedures

A MOM for the automated flow meter, multi-parameter probe, and automated sampler data collection is attached as Appendix C of this document.

Storm-water sample collection will follow the field sampling procedures for conventional and microbiological parameters documented in the TCEQ Surface Water Quality Monitoring Procedures Manual (most recent addition).

The sample volumes, container types, minimum sample volume, preservation requirements, and holding time requirements are specified in Table B2.2.

Table B2.1 Methods and Equipment for Continuous Water-Quality Monitoring

| River Basin | Station Location | MeteoStar /LEADS Data Averaging Time | Sampling Method | Measurement Equipment | Telemetry | Station Parameters |
|-------------|------------------|--------------------------------------|-----------------|-------------------------|----------------|--|
| Colorado | Antioch Cave BMP | TBD | Sonde: In situ | Troll 9500 Isco 2150 | Wireless Modem | Surface Temperature Surface SC Surface DO Surface Turbidity Stream Stage |
| Colorado | Site B | TBD | Sonde: In-situ | Troll 9500 Isco 2150 | Wireless Modem | Surface Temperature Surface SC Surface DO Surface Turbidity Stream Stage |

Table B2.2 Stormwater and Base Flow Monitoring

| Parameter | Matrix | Sample Type | Container | Preservation | Sample Volume | Holding Time |
|------------------------|--------|-------------|-----------------|------------------------------------|---------------|--------------|
| Total Dissolved Solids | Water | Grab | 500 mL HDPE | Ice, <6 °C not frozen | 500 mL | 7 days |
| Nitrite+nitrate-N | water | Grab | 250 mL HDPE | Ice, <6 °C not frozen, H2SO4, pH<2 | 250 mL | 28 days |
| Total Phosphorus-P | water | Grab | 250 mL HDPE | Ice, <6 °C not frozen, H2SO4, pH<2 | 250 mL | 28 days |
| Total Suspended Solids | water | Grab | 1000 mL HDPE | Ice, <6 °C not frozen | 1000 mL | 7 days |
| Turbidity | water | Grab | 500 mL HDPE | Ice, <6 °C not frozen | 250 mL | 28 days |

Processes to Prevent Cross Contamination

Procedures outlined in the *TCEQ Surface Water Quality Procedures Manual* outline the necessary steps to prevent cross-contamination of samples. These include such things as direct collection into sample containers and the use of commercially pre-cleaned sample containers.

Documentation of Field Sampling Activities

Field sampling activities are documented on the Field Data Reporting Form as presented in Appendix D. For all visits, station ID, location, sampling time, sampling date, sampling depth, preservatives added to samples, and sample collector's name/signature are recorded. Values for all measured field parameters collected from the sonde are recorded. Detailed observational data are recorded including water appearance, weather, unusual odors, specific sample information, missing parameters, and flow severity.

Recording Data

For the purposes of this section and subsequent sections, all personnel follow the basic rules for recording information as documented below:

1. Legible writing in indelible, waterproof ink with no modifications, write-overs or cross-outs;
2. Changes should be made by crossing out original entries with a single line, entering the changes, and initialing and dating the corrections.
3. Close-outs on incomplete pages with an initialed and dated diagonal line.

Deficiencies, Nonconformances and Corrective Action Related to Sampling Requirements

Deficiencies are defined as unauthorized deviation from procedures documented in the QAPP. Nonconformances are deficiencies which affect quality and render the data unacceptable or indeterminate. Deficiencies related to sampling methods requirements include, but are not limited to, such things as sample container, volume, and preservation variations, improper/inadequate storage temperature, holding-time exceedances, and sample site adjustments.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the cognizant field or laboratory supervisor who will notify the BSEACD Project Manager. The BSEACD Project Manager will notify the BSEACD QAO of the potential nonconformance within 24 hours. The BSEACD QAO will initiate a Nonconformance Report (NCR) to document the deficiency.

The BSEACD Project Manager, in consultation with BSEACD QAO (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the NCR will be completed accordingly and the NCR closed. If it is determined a nonconformance does exist, the BSEACD Project Manager in consultation with BSEACD QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the BSEACD QAO by completion of a Corrective Action Report.

Corrective Action Reports (CARs) document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TCEQ immediately both verbally and in writing.

B3 Sampling Handling and Custody

See Section B10 of the CWQMN QAPP for electronic managing of Continuous Water Quality Monitoring Network data. Water quality is measured *in situ* for the sonde instrumentation.

Sample Labeling

Samples from the field are labeled on the container with an indelible marker. Label information includes:

1. Site identification
2. Date and time of collection
3. Preservative added, if applicable
4. Sample type (i.e., analysis(es)) to be performed

Sample Handling

The following sampling and related equipment will be required for each sampling event:

- Sample bottles for the required analyses, duplicates, field blanks, etc.
- ISCO samplers
- De-ionized water
- Ice chest
- Ice
- Field data sheets and/or field log book
- Chain-of-custody forms
- Sample labels

Immediately after filling, sample bottles will be dried and labeled.

Sample-bottle labels that are adhesive backed and capable of being attached directly to the sample containers will be used. The following information will be entered on the sample label as a minimum:

Date
Time
Location
Sample type
Sampler name
Sample identification (ID) number
Preservative (if necessary)

Other information may be entered on the sample label if space permits. However, any information entered on the label will not obscure the required information. Sample labels will be either be preprinted and filled out or may be written directly on sample bottles / containers with waterproof ink.

Chain-of-Custody

A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The COC form is used to document sample handling during transfer from the field to the laboratory and among contractors. The following information concerning the sample is recorded on the COC form (See Appendix E).

1. Date and time of collection
2. Site identification
3. Sample matrix
4. Number of containers
5. Preservative used or if the sample was filtered
6. Analyses required
7. Name of collector
8. Custody transfer signatures and dates and time of transfer
9. Name of laboratory admitting the sample

The chain-of-custody form will be filled out for each sample at the time of sampling (an example of this form is provided in Appendix E). The chain-of-custody form will accompany the sample from the time the sample is collected in the field until the sample is analyzed by the laboratory. All chain-of-custody forms received by the laboratories will be signed and dated by the receiving personnel at the laboratory. At the completion of analyses, the laboratory will return a completed copy of the form to the project data manager to complete the chain-of-custody record.

All samples received by the laboratory will be carefully checked for condition of sample containers, label ID, and chain-of-custody forms. Any discrepancies will be noted and reported to the data manager and field supervisor. At receipt, each sample will be assigned a unique laboratory ID number. Internal chain-of-custody procedures will use this number to track the sample from storage through all analytical procedures, and will ultimately track the remaining sample back to storage after analyses. For all analyses, samples will be maintained in secure storage until data quality assessments have been completed and the Project Manager has verified that no repeat analyses are required.

Deficiencies, Nonconformances and Corrective Action Related to Chain-of Custody

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the cognizant field or laboratory supervisor who will notify the BSEACD Project Manager. The BSEACD Project Manager will notify the BSEACD QAO of the potential nonconformance within 24 hours. The BSEACD QAO will initiate a Nonconformance Report (NCR) to document the deficiency.

The BSEACD Project Manager, in consultation with BSEACD QAO (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the NCR will be completed accordingly and the NCR closed. If it is determined a nonconformance does exist, the BSEACD Project Manager in consultation with BSEACD QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the BSEACD QAO by completion of a Corrective Action Report.

Corrective Action Reports (CARs) document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each

corrective action will be documented. CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TCEQ immediately both verbally and in writing.

Sample Tracking

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sampling and continuing through transport, sample receipt, preparation, and analysis.

A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The COC form is used to document sample handling during transfer from the field to the laboratory and among contractors. The following information concerning the sample is recorded on the COC form (See Appendix E).

1. Date and time of collection
2. Site identification
3. Sample matrix
4. Number of containers
5. Preservative used
6. Was the sample filtered?
7. Analyses required
8. Name of collector
9. Custody transfer signatures and dates and time of transfer
10. Bill of lading (*if applicable*)

Deficiencies, Nonconformances and Corrective Action Related to Chain-of Custody

Deficiencies are defined as unauthorized deviation from procedures documented in the QAPP. Nonconformances are deficiencies which affect quality and render the data unacceptable or indeterminate. Deficiencies related to chain-of-custody include but are not limited to delays in transfer, resulting in holding time violations; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the cognizant field or laboratory supervisor who will notify the BSEACD Project Manager. The BSEACD Project Manager will notify the BSEACD QAO of the potential nonconformance within 24 hours. The BSEACD QAO will initiate a Nonconformance Report (NCR) to document the deficiency.

The BSEACD Project Manager, in consultation with BSEACD QAO (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the NCR will be completed accordingly and the NCR closed. If it is determined a nonconformance does exist, the BSEACD Project Manager in consultation with BSEACD QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the BSEACD QAO by completion of a Corrective Action Report.

Corrective Action Reports (CARs) document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each

action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TCEQ immediately both verbally and in writing.

B4 Analytical Methods

The analytical methods are listed in Table A7.1 of Section A7. Laboratories collecting data under this QAPP are compliant with the NELAC Standards.

Copies of laboratory SOPs are retained by BSEACD and are available for review by the TCEQ. Laboratory SOPs are consistent with EPA requirements as specified in the method.

The District will follow and adhere to Section B4 of the CWQMN QAPP, excluding the Continuous Monitoring Auto Analyzer or equivalent equipment.

Standards Traceability

All standards used in the field and laboratory are traceable to certified reference materials. Standards and reagent preparation is fully documented and maintained in a standards log book. Each documentation includes information concerning the standard or reagent identification, starting materials, including concentration, amount used and lot number; date prepared, expiration date and preparer's initials/signature. The bottle is labeled in a way that will trace the standard or reagent back to preparation. Standards or reagents used are documented each day samples are prepared or analyzed.

Deficiencies, Nonconformances and Corrective Action Related to Analytical Method

Deficiencies are defined as unauthorized deviation from procedures documented in the QAPP. Nonconformances are deficiencies which affect quality and render the data unacceptable or indeterminate. Deficiencies related to chain-of-custody include but are not limited to delays in transfer, resulting in holding time violations; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the cognizant field or laboratory supervisor who will notify the BSEACD Project Manager. The BSEACD Project Manager will notify the BSEACD QAO of the potential nonconformance within 24 hours. The BSEACD QAO will initiate a Nonconformance Report (NCR) to document the deficiency.

The BSEACD Project Manager, in consultation with BSEACD QAO (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the NCR will be completed accordingly and the NCR closed. If it is determined a nonconformance does exist, the BSEACD Project Manager in consultation with BSEACD QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the BSEACD QAO by completion of a Corrective Action Report.

Corrective Action Reports (CARs) document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each

action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TCEQ immediately both verbally and in writing.

B5 Quality Control

The District will follow and adhere to the Section B5 of the CWQMN QAPP, excluding the Continuous Monitoring Auto Analyzer or equivalent equipment.

Sampling Quality Control Requirements and Acceptability Criteria

Field Split - A field split is a single sample subdivided by field staff immediately following collection and submitted to the laboratory as two separately identified samples according to procedures specified in the SWQM Procedures. Split samples are preserved, handled, shipped, and analyzed identically and are used to assess variability in all of these processes. Field splits apply to conventional samples only. One field split will be taken for every 10 sample.

The precision of field split results is calculated by relative percent difference (RPD) using the following equation:

$$RPD = (X1 - X2) / ((X1 + X2) / 2)$$

A 30% RPD criteria will be used to screen field split results as a possible indicator of excessive variability in the sample handling and analytical system. If it is determined that elevated quantities of analyte (i.e., > 5 times the RL) were measured and analytical variability can be eliminated as a factor, than variability in field split results will primarily be used as a trigger for discussion with field staff to ensure samples are being handled in the field correctly. Some individual sample results may be invalidated based on the examination of all extenuating information. The information derived from field splits is generally considered to be event specific and would not normally be used to determine the validity of an entire batch; however, some batches of samples may be invalidated depending on the situation. Professional judgment during data validation will be relied upon to interpret the results and take appropriate action. The qualification (i.e., invalidation) of data will be documented on the Data Summary. Deficiencies will be addressed as specified in this section under Deficiencies, Nonconformances, and Correction Action related to Quality Control.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Method Specific QC requirements – QC samples, other than those specified later this section, are run (e.g., sample duplicates, surrogates, internal standards, continuing calibration samples, interference check samples, positive control, negative control, and media blank) as specified in the methods. The requirements for these samples, their acceptance criteria or instructions for establishing criteria, and corrective actions are method-specific.

Detailed laboratory QC requirements and corrective action procedures are contained within the individual laboratory quality manuals (QMs). The minimum requirements that all participants abide by are stated below.

LOQ Check Standard – An LOQ check standard consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system at the lower limits of analysis. The LOQ check standard is spiked into the sample matrix at a level less than or near the LOQ for each analyte for each batch samples that are run.

The LOQ check standard is carried through the complete preparation and analytical process. LOQ Check Standards are run at a rate of one per analytical batch. A batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples.

The percent recovery of the LOQ check standard is calculated using the following equation in which %R is percent recovery, SR is the sample result, and SA is the reference concentration for the check standard:

$$\%R = SR/SA * 100$$

Measurement performance specifications are used to determine the acceptability of LOQ Check Standard analyses as specified in Table A7.1.

Laboratory Control Sample (LCS) - An LCS consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system. The LCS is spiked into the sample matrix at a level less than or near the mid point of the calibration for each analyte. In cases of test methods with very long lists of analytes, LCSs are prepared with all the target analytes and not just a representative number, except in cases of organic analytes with multippeak responses.

The LCS is carried through the complete preparation and analytical process. LCSs are run at a rate of one per analytical batch. A batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples.

Results of LCSs are calculated by percent recovery (%R), which is defined as 100 times the measured concentration, divided by the true concentration of the spiked sample.

The following formula is used to calculate percent recovery, where %R is percent recovery; SR is the measured result; and SA is the true result:

$$\%R = SR/SA * 100$$

Measurement performance specifications are used to determine the acceptability of LCS analyses as specified in Table A7.1.

Laboratory Duplicates – A laboratory duplicate is prepared by taking aliquots of a sample from the same container under laboratory conditions and processed and analyzed independently. A laboratory control sample duplicate (LCS D) is prepared in the laboratory by splitting aliquots of an LCS. Both samples are carried through the entire preparation and analytical process. LCS Ds are used to assess precision and are

performed at a rate of one per batch. A batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples.

For most parameters, precision is calculated by the relative percent difference (RPD) of LCS duplicate results as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set. For duplicate results, X_1 and X_2 , the RPD is calculated from the following equation:

$$RPD = (X_1 - X_2) / \{(X_1 + X_2) / 2\} * 100$$

Measurement performance specifications are used to determine the acceptability of duplicate analyses-as specified in Table A7.1. The specifications for bacteriological duplicates in Table A7.1 apply to samples with concentrations > 10 org./100mL.

Laboratory equipment blank - Laboratory equipment blanks are prepared at the laboratory where collection materials for metals sampling equipment are cleaned between uses. These blanks document that the materials provided by the laboratory are free of contamination. The QC check is performed before the metals sampling equipment is sent to the field. The analysis of laboratory equipment blanks should yield values less than the LOQ. Otherwise, the equipment should not be used.

Matrix spike (MS) -Matrix spikes are prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Percent recovery of the known concentration of added analyte is used to assess accuracy of the analytical process. The spiking occurs prior to sample preparation and analysis. Spiked samples are routinely prepared and analyzed at a rate of 10% of samples processed, or one per batch whichever is greater. A batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples. The information from these controls is sample/matrix specific and is not used to determine the validity of the entire batch. The MS is spiked at a level less than or equal to the midpoint of the calibration or analysis range for each analyte. Percent recovery (%R) is defined as 100 times the observed concentration, minus the sample concentration, divided by the true concentration of the spike.

The results from matrix spikes are primarily designed to assess the validity of analytical results in a given matrix and are expressed as percent recovery (%R). The laboratory shall document the calculation for %R. The percent recovery of the matrix spike is calculated using the following equation in which %R is percent recovery, SSR is the observed spiked sample concentration, SR is the sample result, and SA is the reference concentration of the spike added:

$$\%R = (SSR - SR) / SA * 100$$

Measurement performance specifications for matrix spikes are not specified in this document.

The results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory shall determine the internal criteria and document the

method used to establish the limits. For matrix spike results outside established criteria, corrective action shall be documented or the data reported with appropriate data qualifying codes.

Method blank –A method blank is a sample of matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as the samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination from the analytical process. The analysis of method blanks should yield values less than the LOQ. For very high-level analyses, the blank value should be less than 5% of the lowest value of the batch, or corrective action will be implemented.

Deficiencies, Nonconformances and Corrective Action Related to Quality Control

Deficiencies are defined as unauthorized deviation from procedures documented in the QAPP. Nonconformances are deficiencies which affect quality and render the data unacceptable or indeterminate. Deficiencies related to chain-of-custody include but are not limited to delays in transfer, resulting in holding time violations; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the cognizant field or laboratory supervisor who will notify the BSEACD Project Manager. The BSEACD Project Manager will notify the BSEACD QAO of the potential nonconformance within 24 hours. The BSEACD QAO will initiate a Nonconformance Report (NCR) to document the deficiency.

The BSEACD Project Manager, in consultation with BSEACD QAO (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the NCR will be completed accordingly and the NCR closed. If it is determined a nonconformance does exist, the BSEACD Project Manager in consultation with BSEACD QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the BSEACD QAO by completion of a Corrective Action Report.

Corrective Action Reports (CARs) document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TCEQ immediately both verbally and in writing.

B6 Instrument/Equipment Testing, Inspection and Maintenance

The District will follow and adhere to Section B6 of the CWQMN QAPP, excluding the Continuous Monitoring Auto Analyzer or equivalent equipment.

Automated sampler testing and maintenance requirements are contained with Appendix H of this document.

All instream sampling equipment testing and maintenance requirements are detailed in the TCEQ Surface Water Quality Monitoring Procedures. Equipment records are kept on all field equipment and a supply of critical spare parts is maintained by the BSEACD Field Supervisor.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory QAM(s). Testing and maintenance records are maintained and are available for inspection by the TCEQ. Instruments requiring daily or in-use testing may include, but are not limited to, water baths, ovens, autoclaves, incubators, refrigerators, and laboratory pure water. Critical spare parts for essential equipment are maintained to prevent downtime. Maintenance records are available for inspection by the TCEQ.

B7 Instrument/Equipment Calibration and Frequency

The District will follow and adhere to Section B7 of the CWQMN QAPP, excluding the Continuous Monitoring Auto Analyzer or equivalent equipment.

Calibration requirements for the automated monitoring equipment is included in Appendix I of this document.

Instream field Equipment calibration requirements are contained in the TCEQ Surface Water Quality Monitoring Procedures Manual. Post calibration error limits and the disposition resulting from error are adhered to. Data not meeting post-error limit requirements invalidates associated data collected subsequent to the pre-calibration and are not submitted to the TCEQ.

Detailed laboratory calibrations are contained within the QAM(s).

B8 Inspection/Acceptance of Supplies and Consumables

New batches of supplies are tested before use to verify that they function properly and are not contaminated. The laboratory QAM provides additional details on acceptance requirements for laboratory supplies and consumables.

The District will follow and adhere to Section B8 of the CWQMN QAPP, excluding the Continuous Monitoring Auto Analyzer or equivalent equipment.

B9 Non-direct Measurements

Non-direct measurements from computer databases, spreadsheets, programs, etc., specifically historical data acquisition, will not be used to meet the laboratory objectives of this QAPP.

B10 Data Management

The District will follow and adhere to Section B10 of the CWQMN QAPP, excluding the Continuous Monitoring Auto Analyzer or equivalent equipment.

Data Path

Samples are collected and are transferred to the laboratory for analyses as described in Sections B1 and B2. Analytical data will be sent electronically via email from the laboratory to BSEACD. Sampling information (e.g. site location, date, time, sampling depth, etc.) is used to generate a unique sampling event in an interim database built on an autogenerated alphanumeric key field. Measurement results from both the field data sheets and laboratory data sheets are manually entered into the interim database for their corresponding event. Customized data entry forms facilitate accurate data entry. Following data verification and validation, the data are exported in a format specified by the TCEQ project Manager.

Record-keeping and Data Storage

BSEACD recordkeeping and document control procedures are contained in the water quality sampling and laboratory standard operating procedures (SOPs) and this QAPP. Original field and laboratory data sheets are stored in the BSEACD offices in accordance with the record-retention schedule in Section A9. One copy of the database is backed up each Friday on magnetic tape and is stored off-site. If necessary, disaster recovery will be accomplished by information resources staff using the backup database.

Data Verification/Validation

The control mechanisms for detecting and correcting errors and for preventing loss of data during data reduction, data reporting, and data entry are contained in Sections D1, D2, and D3.

Forms and Checklists

See Appendix D for the Field Data Reporting Form. See Appendix E for the Chain-of-Custody Form.

Data Handling

Data are processed using the Microsoft Access 2000 suite of tools and applications. Data integrity is maintained by the implementation of password protections which control access to the database and by limiting update rights to a select user group. No data from external sources are maintained in the database. The database administrator is responsible for assigning user rights and assuring database integrity.

Hardware and Software Requirements

Hardware configurations are sufficient to run Microsoft Access 2000 under the Windows NT operating system in a networked environment. Information resources staff are responsible for assuring hardware configurations meet the requirements for running current and future data management/database software as well as providing technical support. Software development and database administration are also the responsibility of the information resources department. Information resources develops applications based on user requests and assures full system compatibility prior to implementation.

Information Resource Management Requirements

BSEACD information technology (IT) policy is contained in IT SOPs which are available for review at BSEACD offices.

C1 Assessment and Response Actions

Table C1.1 Assessments and Response Actions

| Assessment Activity | Approximate Schedule | Responsible Party | Scope | Response Requirements |
|-----------------------------------|--|--------------------------|---|---|
| Status Monitoring Oversight, etc. | Continuous | BSEACD Project Manager | Monitoring of the project status and records to ensure requirements are being fulfilled. | Report to TCEQ in Quarterly Report |
| Laboratory Inspections | Dates to be determined by the TCEQ lab inspector | TCEQ Lab Inspector | Analytical and quality control procedures employed at the laboratory and the contract laboratory | 30 days to respond in writing to the TCEQ to address corrective actions |
| Monitoring Systems Audit | Dates to be determined by TCEQ | TCEQ QAS | The assessment will be tailored in accordance with objectives needed to assure compliance with the QAPP. Field sampling, handling and measurement; facility review; and data management as they relate to the NPS Project | 30 days to respond in writing to the TCEQ to address corrective actions |
| Laboratory Inspection | Based on work plan and or discretion of BSEACD | BSEACD QAO | Analytical and quality control procedures employed at the laboratory and the contract laboratory | 30 days to respond in writing to the BSEACD QAO to address corrective actions |
| Monitoring Systems Audit | Based on work plan and or discretion of BSEACD | BSEACD QAO | The assessment will be tailored in accordance with objectives needed to assure compliance with the QAPP. Field sampling, handling and measurement; facility review; and data management as they relate to the NPS Project | 30 days to respond in writing to the BSEACD QAO to address corrective actions |
| Site Visit | Dates to be determined by TCEQ | TCEQ PM | Status of activities. Overall compliance with work plan and QAPP | As needed |

Corrective Action

The BSEACD Project Manager is responsible for implementing and tracking corrective action procedures as a result of audit findings. Records of audit findings and corrective actions are maintained by both the TCEQ PM and the BSEACD QAO.

If audit findings and corrective actions cannot be resolved, then the authority and responsibility for terminating work is specified in the TCEQ QMP and in agreements or contracts between participating organizations.

C2 Reports to Management

Reports to TCEQ Project Management

All reports detailed in this section are contract deliverables and are transferred to the TCEQ in accordance with contract requirements.

Quarterly Progress Report - Summarizes the BSEACD's activities for each task; reports problems, delays, and corrective actions; and outlines the status of each task's deliverables.

Monitoring Systems Audit Report and Response - Following any audit performed by the Basin Planning Agency, a report of findings, recommendations and response is sent to the TCEQ in the quarterly progress report.

Monitoring System Audit Response - BSEACD will respond in writing to the TCEQ within 30 upon receipt of a monitoring system audit report to address corrective actions.

Contractor Evaluation - BSEACD participates in a Contractor Evaluation by the TCEQ annually for compliance with administrative and programmatic standards.

Monitoring Report- Provides data collected for the project and a summary of the data.

Final Project Report - Summarizes the BSEACD's activities for the entire project period including a description and documentation of major project activities; evaluation of the project results and environmental benefits; and a conclusion.

Reports to BSEACD Project Management

All laboratory analytical reports and applicable QA/QC data related to field and laboratory analysis will be collected and archived by the BSEACD and LCRA ELS.

Reports by TCEQ Project Management

Contractor Evaluation - BSEACD participates in a Contractor Evaluation by the TCEQ annually for compliance with administrative and programmatic standards. Results of the evaluation are submitted to the TCEQ Financial Administration Division, Procurement and Contracts Section.

D1 Data Review, Verification, and Validation

For the purposes of this document, data verification is a systematic process for evaluating performance and compliance of a set of data to ascertain its completeness, correctness, and consistency using the methods and criteria defined in the QAPP. Validation means those processes taken independently of the data-generation processes to evaluate the technical usability of the verified data with respect to the planned objectives or intention of the project. Additionally, validation can provide a level of overall confidence in the reporting of the data based on the methods used.

All data obtained from field and laboratory measurements will be reviewed and verified for conformance to project requirements, and then validated against the data quality objectives which are listed in Section A7. Only those data which are supported by appropriate quality control data and meet the measurement performance specification defined for this project will be considered acceptable and used in the project.

The procedures for verification and validation of data are described in Section D2, below. The BSEACD Field Supervisor is responsible for ensuring that field data are properly reviewed and verified for integrity. The Laboratory Supervisor is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and bias, and reviewed for integrity. The BSEACD Data Manager will be responsible for ensuring that all data are properly reviewed and verified, and submitted in the required format to the project database. The BSEACD QAO is responsible for validating a minimum of 10% of the data produced in each task. Finally, the BSEACD Project Manager, with the concurrence of the BSEACD QAO, is responsible for validating that all data to be reported meet the objectives of the project and are suitable for reporting to TCEQ.

The District will follow and adhere to Section D1 of the CWQMN QAPP for data review, verification, and validation of CWQMN data.

D2 Verification and Validation Methods

All data will be verified to ensure they are representative of the samples analyzed and locations where measurements were made, and that the data and associated quality control data conform to project specifications. The staff and management of the respective field, laboratory, and data management tasks are responsible for the integrity, validation and verification of the data each task generates or handles throughout each process. The field and laboratory tasks ensure the verification of raw data, electronically generated data, and data on chain-of-custody forms and hard copy output from instruments.

Verification, validation and integrity review of data will be performed using self-assessments and peer review, as appropriate to the project task, followed by technical review by the manager of the task. The data to be verified are evaluated against project performance specifications (Section A7) and are checked for errors, especially errors in transcription, calculations, and data input. If a question arises or an error is identified, the manager of the task responsible for generating the data is contacted to resolve the issue. Issues which can be corrected are corrected and documented electronically or by initialing and dating the associated paperwork. If an issue cannot be corrected, the task manager consults with higher level project management to establish the appropriate course of action, or the data associated with the issue are rejected.

The BSEACD Project Manager and QAO are each responsible for validating that the verified data are scientifically valid, defensible, of known precision, bias, integrity, meet the data quality objectives of the

project, and are reportable to TCEQ. One element of the validation process involves evaluating the data again for anomalies. Any suspected errors or anomalous data must be addressed by the manager of the task associated with the data, before data validation can be completed.

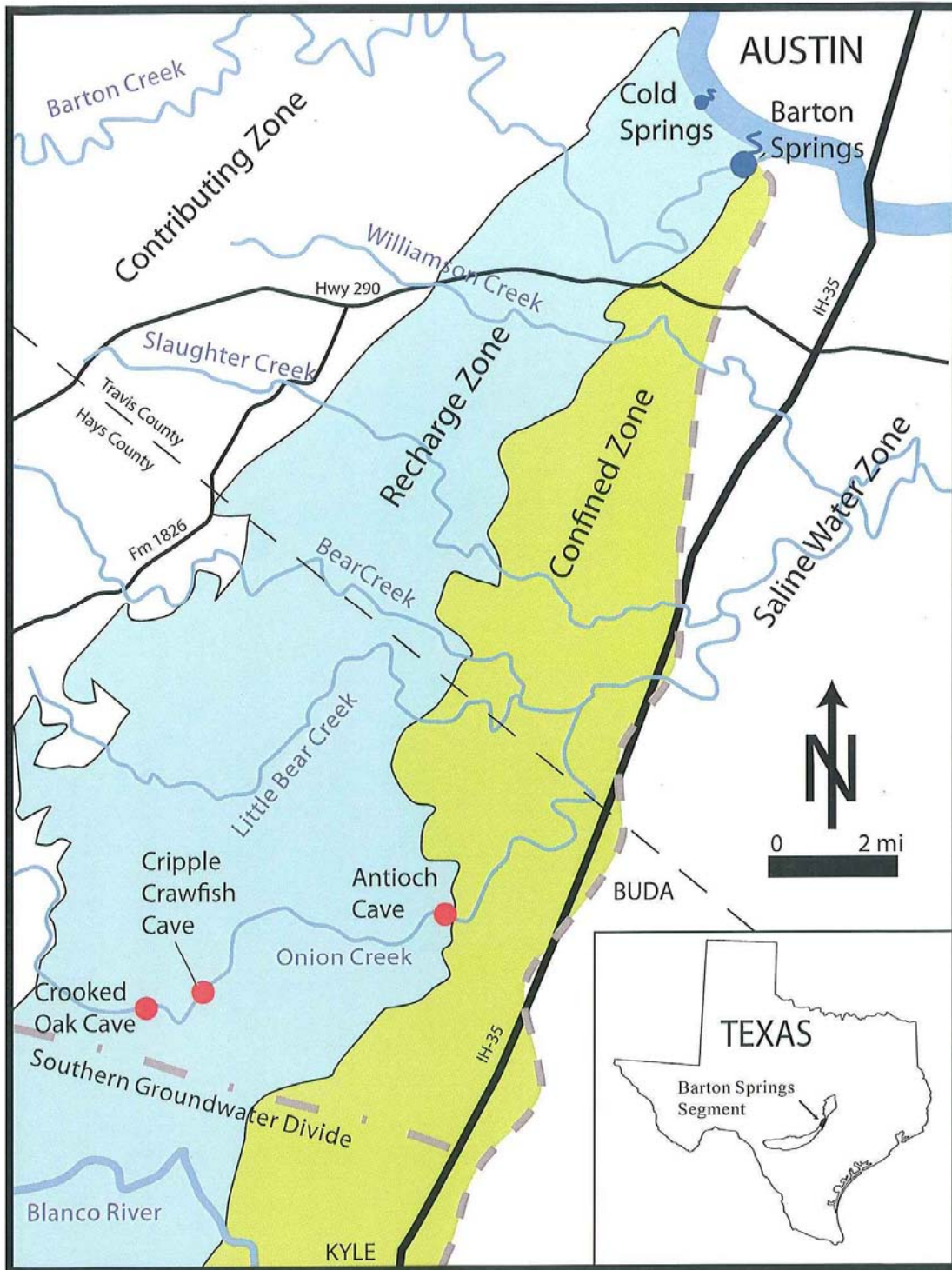
A second element of the validation process is consideration of any findings identified during the monitoring systems audit conducted by the TCEQ QAS assigned to the project. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed. Finally, the BSEACD Project Manager, with the concurrence of the QAO validates that the data meet the data quality objectives of the project and are suitable for reporting to TCEQ.

The District will follow and adhere to Section D2 of the CWQMN QAPP for verification and validation of CWQMN data.

D3 Reconciliation with User Requirements

Data collected from this project will be analyzed by the BSEACD to report the performance of the BMP and the measured reductions in NPS loadings. The percentage of pollutant removal achieved as a result of the storm water ponds performance will be one of several criteria examined by BSEACD in the design and sizing of similar BMPs to be constructed in other segments of Onion Creek. Neither BMP nor instream monitoring data that do not meet requirements will not be used in the project or submitted to the SWQMIS.

Appendix A. Area Location Map



Appendix B. Workplan

Work plan approved under fiscal year 2006, 319h grant application.

Appendix C. Data Summary

NPS DATA SUMMARY

A completed checklist must accompany all data sets submitted to the TCEQ by the Contractor.

Data Quality Review

- A. Are all the "less-than" values reported at or below the specified reporting limit? _____
- B. Have checks on correctness of analysis or data reasonableness performed? _____
e.g.: Is ortho-phosphorus less than total phosphorus? _____
Are dissolved metal concentrations less than or equal to total metals? _____
- C. Have at least 10% of the data in the data set been reviewed against the field and laboratory data sheets? _____
- D. Are all *Storetcodes* in the data set listed in the QAPP? _____
- E. Are all *StationIds* in the data set listed in the QAPP? _____

Documentation Review

- A. Are blank results acceptable as specified in the QAPP? _____
- B. Was documentation of any unusual occurrences that may affect water quality included in the *Event* table's *Comments* field? _____
- C. Were there any failures in sampling methods and/or deviations from sample design requirements that resulted in unreportable data? If yes, explain on next page.
- D. Were there any failures in field and laboratory measurement systems that were not resolvable and resulted in unreportable data? If yes, explain on next page.

Describe any data reporting inconsistencies with performance specifications. Explain failures in sampling methods and field and laboratory measurement systems that resulted in data that could not be reported to the TCEQ. (attach another page if necessary):

Date Submitted to TCEQ: _____

TAG Series: _____

Date Range: _____

Data Source: _____

Comments (attach file if necessary): _____

Contractor's Signature: _____

Date: _____

Appendix D. Manufacturer's Operator Manuals



Level **TROLL**[®]
OPERATOR'S
MANUAL

Level **TROLL 300**
Level **TROLL 500**
Level **TROLL 700**
BaroTROLL



September 2007

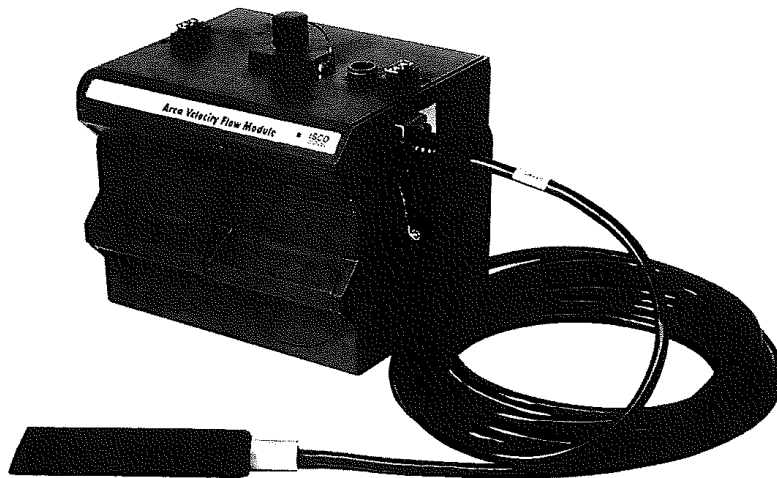


Multi-Parameter TROLL 9500
WQP - 100
OPERATOR'S MANUAL



2150 Area Velocity Flow Module and Sensor

Installation and Operation Guide



Part #60-2003-092 of Assembly #60-2004-038
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Revision K, January 2005

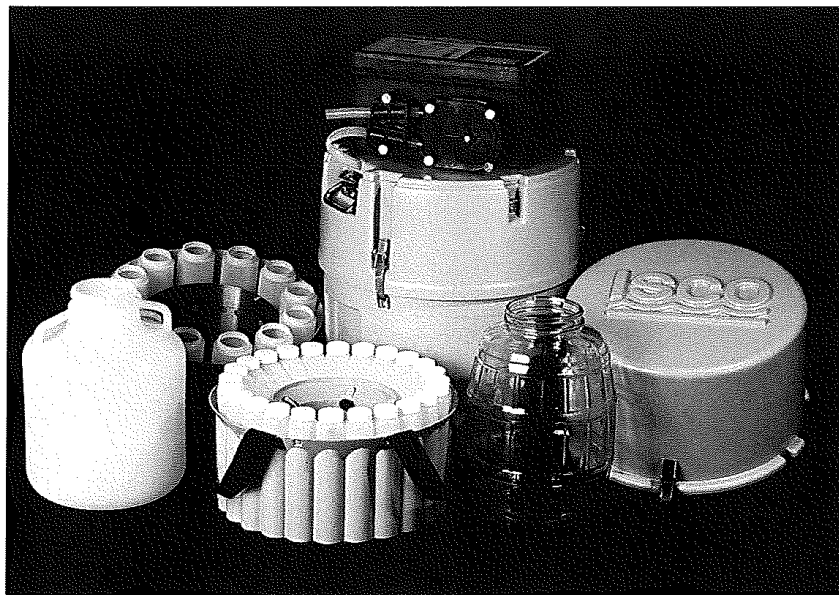
Appendix E. Field Data Reporting Form

Appendix F. Chain-of-Custody Form

Appendix G. Automated Sampler Testing with Maintenance and Calibration Requirements

3700 Portable Samplers

Installation and Operation Guide



Part #60-3703-267 of Assembly #60-3704-101
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Revision EE, March 20, 2007